Title of research: Adoption of True Potato Seed (TPS) as Planting Technique in Tripura: Levels and Dynamics

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CONTENTS

1	Introduction
2	Review of literature
3	Research setting
4	Research methodology I. Sampling methods II. Variables and measurement III. Methods of data collection IV. Statistical analysis
5	Utility of the study
6	Implication
7	References

1. INTRODUCTION

Potato is a major food crop, grown more than 100 countries in world. The higher biological efficiency and the highest rate of dry matter production day -1 unit -1 area make it inevitable and important component in our food security system (Edison, 2005) and hence it is known as .Poor man's food. The native South Americans brought Potato under cultivation possibly 2000 years before the Spanish conquest. In 1537, the Spaniards first came into contact with potato in one of the villages of Andes. In Europe, it was introduced between 1580 A.D. to 1585 A.D. in Spain, Portugal, Italy, France, Belgium and Germany. At present, China, Russia, India, Poland and U.S.A. contribute a major share of total world production. It was introduced in India by the Portuguese sailors during early 17th century and its cultivation was spread to North India by the British. Potato is one of the main commercial crops grown in the country. It is cultivated in 23 States in India. This country has achieved a tremendous growth in potato production during last four to five decades.

It produces more food per unit area as compared to cereal and also provides more return in a much shorter period of time. In world scenario, India became the second largest producer of potato (Scott and Suarez, 2011). India produced 42.34 million tons from 1.86 million ha with an average yield of 22.72 t/ ha of Potato during 2010-11 (Agricultural statistics at a glance, 2012). The North-eastern hill (NEH) region is situated in the Eastern part of the Indian Himalayas and comprises 8 states, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The NEH region lies between 21° to 29° North latitude and 89°to 98° East longitude and is characterized by hot sub-humid (moist) to humid agro-climate in the Assam plains and warm per-humid in the hilly areas of the region. Nearly 10% of the total geographical area in India comes under the NEH region and has about 10% of the country's total potato area. In all the NEH states, except Tripura, potato yield has been low ranging between 4-11t/ ha and much below the national average (18.2 t/ha).The major constraints to potato production in the NEH states are:

i) Non-availability and high cost of quality tuber seed, ii) inadequate availability of inputs like fertilizers and plant protection chemicals, iii) poor management practices followed by the potato growers and iv) perpetuation of serious potato diseases like late blight, brown rot, bacterial wilt, viruses, etc. occurring due to favorable agro-climate that adversely affect the production of quality seed potatoes in the region. Potato tuber seed in majority of the NEH states is therefore, regularly procured from distant places in the North levying heavily on the

farmers due to long distance transportation of seed tubers and adding to the cost of seed. Besides, there has been acute shortage of the cold stores for potato storages in the entire NEH region. There are hardly 3-4 cold stores that too only in Assam and Tripura, which are not sufficient enough even to accommodate seed potatoes of all the farmers in these two states. Although the improved Indian potato varieties, viz., Kufri Jyoti, Kufri Megha are being used by the farmers in NEH region, yet local cultivars are preferred for the taste and better storability under ambient conditions/ country stores. A large number of farmers in the NEH region are therefore, still using seed mostly of the local cultivars, which they store in their houses until next planting season. Seed tubers thus stored under the warm per-humid condition for nearly eight months become shriveled and physiologically too old by the planting time and result in low yields. Therefore farmer are adopting different kinds of potato plating techniques in order to increase the production and productivity of potato.

Adoption and diffusion of innovations theory (Rogers, 1995) has been widely used to identify factors that influence an individual's decision to adopt or reject an innovation. Adoption behavior of farmers has been attempted to get explained mainly in three different ways of adoption phenomenon *viz*. extent of adoption, discontinuance and lastly in terms of re-invention phenomena of human behavior. Adoption is a decision to make full use of an innovation as the best course of action available. Discontinuance is a decision not to adopt an innovation after having previously adopted it. Discontinuance may also take two forms. *Replacement discontinuance* is a decision to reject an idea in order to adopt a better idea that supersedes it. *Disenchantment discontinuance* is a decision to reject an idea as a result of dissatisfaction with its performance. Re-invention is a term which defined as the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. This phenomena often is beneficial to the adopters of an innovation. Flexibility in the process of adopting an innovation may reduce mistakes and encourage customization of the innovation to fit it more appropriately to local situations or changing conditions. As a result of re-invention, an innovation may be more appropriate in matching an adopter's preexisting problems and responsive to new problems that arise during the innovation-decision process. Recognition of the existence of re-invention brings into focus a different view of adoption behavior-instead of simply accepting or rejecting an innovation as a fixed idea. Many a time it has realized that potential adopters on many occasions are active participants in the adoption and diffusion process, to give their own unique meaning to the innovation as it is applied in their local context. The present study is contemplated to identify

the factors that contributed towards diffusion, adoption and dynamics of Potato Planting Techniques in Tripura.

OBJECTIVES OF THE STUDY:

1. To assess the spatio-temporal variations in adoption of potato planting technique.
2. To explore the socio-personal, socio-psychological, agro-economic and communication characteristics of the potato growers.
3. To analyze the adoption behaviour of farmers growing potato through TPS and the factor affecting it.
4. To identify backward and forward linkage mechanisms in diffusion of TPS as potato planting technique.
5. To calculate cost-benefit of TPS as potato planting technique.
6. To find out the strength and limitations of TPS as potato planting technique.

2. REVIEW OF LITERATURE:

Shankar *et al.* (2009) stated that extension contact, farm size, weather knowledge, innovativeness, achievement orientation and risk orientation contributed positively and significantly towards decision making behaviour. The relative importance of these factors reflects both internal environment and external social relations of farmers that pave way for collective nature of decision making attitude. Results are discussed in terms of their implications for future development of decision support systems and technology transfer activities to farmers for better adoption of weather forecasts.

Badodiya *et al*. (2010) observed that, nine package of practices were included for knowing the adoption behavior among the cotton growers and the practices were improved varieties, seed treatment, culture treatment, method of sowing, balanced use of fertilizers, irrigation management, weed control, insect control and disease control and four major categories of factors, namely, (a) Socio-personal factors: (1) Age, (2) Education, (3) Caste, (4) Size of family, and (5) social participation, (b) Economic factors: (1) Size of land holding, (2) Credit availability and (3) Annual income, (c) Socio-communicational factors: (1) Source of information, (2) Contact with extension personnel and (3) Extension

participation and (d) Psychological factors: (1) Innovativeness, (2) Cosmopoliteness,(3) Agriculture belief and (4) Knowledge about cotton production technology.

Pounraj and Rathakrishnan (2011) mentioned that majority (82%) of fish farmers possessed medium to high level of knowledge and more than three-fourth (76%) of them belonged to medium to high level adopter category. The adoption behaviour of fish farmers towards critical inland fish culture technologies was significantly influenced by the factors like, occupation, annual income, land holding, extent of weed infestation, social participation, mass media participation, extension agency contact, cosmopoliteness, innovative proneness, value orientation, risk orientation, economic motivation, knowledge about critical inland fish culture technologies and negatively by their age.

Goswami *et al*. (2012) reported that all the psychological variables (except credit orientation), communication variables, occupation, land holding (socio-economic) and size of water body and duration of water availability (situational variables) had positive significant correlation. Most of the socio-personal, socio-economic and situational variables have no bearings with adoption. Technique of path analysis showed that extension agency contact exhibited highest positive direct effect on adoption behaviour followed by innovative proneness, occupation, economic motivation, knowledge about scientific fish culture. Among the total indirect effects, the highest and lowest impacts were received from the variables cosmopoliteness and caste respectively. Majority of the substantial indirect effects were channelized through economic motivation, family type, occupation, extension agency contact, knowledge and innovative proneness.

Muzari *et al.*(2012) has found that the factors affecting technology adoption are assets, income, institutions, vulnerability, awareness, labour, and innovativeness by smallholder farmers. Technologies that require few assets, have a lower risk premium, and are less expensive have a higher chance of being adopted by smallholder farmers.

Saha *et al.* (2012) stated that fisheries training programme attained, pond size, share of fisheries to total income, knowledge to scientific fish farming, risk taking behaviour, innovativeness and information management behavior were statistically significant at 1% level. Age and distance from market were found negatively and significantly associated with

explaining adoption of improved production practices of carp at 5% significant level. Further, the path analysis revealed that Information management behaviour, training programme attained, potentiality to realize opportunity, innovativeness, knowledge of scientific fish farming occupied the first five rank in that order.

Mehta and Sonawane (2012) observed that the more than half (52.00 %) of the respondents were in middle age group, having primary to secondary level of education (58.00 %) and medium size of land holding (61.00 %). Near half of the (47.00 %) of the respondents possessed more than 75.00 per cent of land under mango cultivation, small size of family (76.00 %), having medium level of income (58.00 %) and medium level of cropping intensity(68.00 %). More than four fifth (82.00 %) of the respondents had medium social participation, near to three fourth (72.00 %) had medium level of awareness regarding value addition, 76.00 per cent of them had medium mango yield index, more than half (53.00 % and 54.00 %) of the mango growers had medium extension participation and medium level of mass media exposure, respectively, 67.00 per cent had medium level of extent of adoption, 65.00 per cent were found in medium category of management orientation. More than half (54.00 %) of mango growers fell in best level of innovativeness, 84.00 per cent of them were in average level of progressiveness and 74.00 per cent of them had average level of knowledge regarding mango cultivation.

3. RESEARCH SETTING

The North-eastern India is a chicken-necked region, connected to the main land with a narrow corridor and surrounded by international boundaries of Bangladesh and Bhutan. North-eastern India consists of Assam, Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim covering 255.08 million hectares, which is about 8 percent of the country‟s landmass. The region is bestowed with rich natural resources of soil, water, climate and biodiversity. The region is highly diverse in terms of agro-ecosystem, socio-cultural mixture of the people, a blend of multiplicity of ethnicity and geo-topographical variability. The renowned agricultural scientist Dr. M S Swaminathan describes the region as a cultural and genetic paradise and granary of mega-biodiversity in terms of flora and fauna. The quality of land in the region is favourable for a wider range of crops, livestock, forestry and fishery activities. North-east India is a rich storehouse of indigenous agricultural practice and

local varieties of crops. The number of people dependent on agriculture is over 86 percent and the production condition in agriculture is traditional.

Macro Setting: State of Tripura:

Present study is proposed to be conducted in the State of Tripura. Tripura is the third smallest state of India located in the north eastern part of India.

Table 1: District wise administrative set-up (as on 2013)

Districts	Sub-division	Block	Panchayats	Revenue Villages	TTAADC Villages	AMC/NP
West Tripura	3	9	90	96	77	4
Shepahijala	3	7	112	119	52	3
Khowai	2	6	55	78	58	2
Gomati	3	8	70	134	95	2
South Tripura	3	8	99	138	70	3
Dhalai	4	8	41	146	96	2
Unokoti	2	4	59	78	28	2
North Tripura	3	8	69	89	51	2
Total	20	58	595	878	527	20

Source: Govt. of Tripura

Tripura is having with a geographical area of 10,491 square km. It is located in the south-west extreme corner of the north-eastern region, between latitudes 22°57' and 24°33' N and longitudes 91°10' and 92°20' E. The state is situated between the river valley of Myanmar and Bangladesh, and is bounded by Bangladesh on the north, west, south and southeast; in the east it has a common boundary with Assam and Mizoram. The state Tripura was a princely state, and Maharaja Birbikram Kishore Manikya Bahadur was the last king of the state. Tripura attained full state on 21st January 1972.

Climate of the State

Tripura has a tropical climate and receives heavy rainfall during the monsoons. The state receives an average annual rainfall of 2197mm.Temperature in the state varies from 10 to 35 degree Celsius.

Agriculture

Tripura is an agrarian state known worldwide for its production of rubber, tea, coffee, raw silk, jute and sandalwood .The state has a 75 per cent share of the total floriculture industry of the country. About 70per cent of the people live in the villages and 71 per cent of the population depends on agriculture. The crops like rice, ragi, jowar, maize and pulses besides oilseeds and number of cash crops. Other crops like cashew nut, coconut, areca nut, chillies, cotton, sugarcane, and tobacco are also grown in the state.

Economy

The economy of the state is primarily agrarian. The primary sector i.e. agricultural contributes about 64 per cent of total employment in the state and about 48 per cent of the State Domestic Product (SDP). A variety of horticultural/plantation crops are produced in Tripura like pineapple, oranges, cashew nut, jackfruit, coconut, tea, rubber, forest plantation etc. There is ample scope for increasing the area under such productions as wells as productivity.

4. RESEARCH METHODOLOGY

A. Sampling Methods:

Multi stage random sampling technique will be followed in present study. Sampling design for primary data collection is presented below:

Districts	Block	Villages	Samples	Total	Sampling technique
	B_1	V_1	25		
		V_2	25		
		V_3	25		

D_1	B_2	V_4	25	300	Random sampling
D_2	B_3	V_5	25		
		V_6	25		
	B_4	V_7	25		
		V_8	25		
D_3	B_5	V_9	25		
		V_{10}	25		
	B_6	V_{11}	25		
		V_{12}	25		

*Proportionate sampling will be done at District, Block and Village level.

Profile of the potato growers:

The socio-personal, agro-economic, socio-psychological and communication variables are such type of variables, which determine the behavior of an individual. Appropriate operationalisation and measurement of the variables help the researcher to land upon the accurate conclusion. Therefore, the selected variables for studying profile of the Potato growers will be operationalised and measured in following manner:

B. Variables and their Measurement

Variables		**Measurement**
Socio-personal		
1	Age(X_1)	On the basis of chronological age at the time of investigation
2	Education level (X_2)	Scale developed by Pareek and Trivedi(1964)
3	Family size(x_3)	Scale developed by Pareek and Trivedi (1964)
4	Tenure status (X_4)	Scored assigned- Tenant-1, Owner-2
5	Occupation (X_5)	Scored assigned- Agri. Lobour-1, Farmer-2, Service-3 and farmer and service-4

Agro-economic		
6	Size of holding (X_6)	Scored assigned- up to 1 acre-1, 1-2.5 acre-2 and more than 2.5 acre-3
7	Cropping intensity (X_7)	Scored assigned-Low- (100-150%), Medium-(151-200%) and High- (>200%)
8	Farm mechanization (X_8)	Scored assigned High-(Mean+S.D), Medium-Between (Mean+S.D)and (mean-S.D) and Low -(mean-S.D)
9	Annual income from agriculture/ farming (X_9)	Scored assigned- High(Rs.60000-120000), Medium(Rs.24000-60000) and Low (below Rs.24000)
10	Irrigation status (X_{10})	Scored assigned- Irrigated-1 and Non-irrigated-2
Socio-psychological		
11	Economic motivation (X_{11})	Scale developed by Moulik (1965)
12	Innovation proneness (X_{12})	Scale developed by Moulik (1965)
13	Independency (X_{13})	Scale developed by Supe (1969)
14	Scientific orientation (X_{14})	Scale developed by Supe (1969)
15	Risk orientation (X_{15})	Scale developed by Supe (1969)
16	Production orientation (X_{16})	Scale developed by Samata (1977)
17	Knowledge about of different Potato Planting Techniques (X_{17})	Scale developed by Choudhury (2000)
18	Perceived benefits of adoption TPS (X_{18})	Scored assigned- SA-5, A-4, U-3,D-2 and SD-1
19	Perceived weakness of TPS (X_{19})	Scored assigned- SA-5, A-4, U-3,D-2 and SD-1
20	Attitude towards of different Potato Planting Techniques (X_{20})	Favorable-1 and Unfavorable-2
Communication		
21	Mass media exposure (X_{21})	Scale developed by Singh (1972)
22	Contact with personal cosmopolite (X_{22})	Scale developed by Singh (1972)
23	Contact with personal localites (X_{23})	Scale developed by Singh (1972)
24	Training received (X_{24})	Scale developed by De and Rao (2000)

Adoption behaviour of farmers:

Adoption behaviour of farmers has been attempted to get explained mainly in three different ways of adoption phenomenon *viz*. extent of adoption, discontinuance and lastly in terms of re-invention phenomena of human behaviour. Adoption is a decision to make full use of an innovation as the best course of action available. Discontinuance is a decision not to adopt an innovation after having previously adopted it. Discontinuance may also take two forms. *Replacement discontinuance* is a decision to reject an idea in order to adopt a better idea that supersedes it. *Disenchantment discontinuance* is a decision to reject an idea as a result of dissatisfaction with its performance. Re-invention is a term which defined as the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. The aforesaid variables of adoption behaviour will be measured in following manner:

Variables		Measurement
1	Extent of adoption (Y1)	Structured schedule developed
2	Extent of discontinuance (Y2)	Structured schedule developed
3	Perceived attributes (Y3)	Structured schedule developed
4	Perceived constraints (Y4)	Structured schedule developed

C. TECHNIQUES OF DATA COLLECTION

The primary data in the present study are to be collected directly from the farmers with the help of structured schedule through personal interview methods. The secondary data will be collected from different published sources.

D. ANALYSIS OF DATA:

The important statistical measures that will be used to analyse the data are:

1. Descriptive statistics such as frequency, percentage, mean, standard deviation, coefficient of variation, etc

2. Relational statistics such as correlation, linear regression, multiple regression, path analysis, factor analysis as per the objectives of the study.
3. Tests of significance like t-test, etc.

5. UTILITY OF THE STUDY:

1. Findings of the study will help identify adoption dynamism of Potato Planting Techniques in terms of its extent of adoption, reasons for partial adoption, non-adoption or discontinuance of technologies.
2. The study will provide valuable information on the agro-economic, socio-psychological and extension communication characteristics of the farmers.
3. The findings will be useful to extension workers, agricultural planners and policy makers to evolve a strategy for effective transfer of technology.
4. Constraints identified in adoption of Potato Planting Techniques process would provide the impetus for potential solutions and future strategies in diffusion of agricultural technology.

6. IMPLICATION:

This study was conducted with a view that its results may be useful to the extension workers, administrators and communication experts, researchers and planners who are engaged in generating the technology and dissemination of improved potato production technology to the farmers. An attempt was made in this study to analyze those factors which would affect the adoption of improved potato production technology and to suggest measures for formulating strategies to increase the adoption of improved potato production technology among the potato growers.As with any new technology to begin with, and might be facing hurdle in its dissemination and utilization as an alternative method of potato production, despite the fact that of different Potato Planting Techniques technology is scientifically sound, technically feasible, economically viable and eco-friendly. Different Potato Planting Techniques provides an opportunity even to small farmers to generate high quality planting material and assures high yields with low inputs as compared to the tuber seed of unknown health status. Although there will be some bottlenecks that hinder *adoption* of different Potato Planting Techniques among the farmers, those could be overcome by further improvement in parental lines by the introgression of desired traits from diverse genetic resources and adjusting the

planting dates as well as agronomic practices according to the local conditions. The success of different Potato Planting Techniques adoption in Tripura can be used as a model in other states of the NEH region.

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